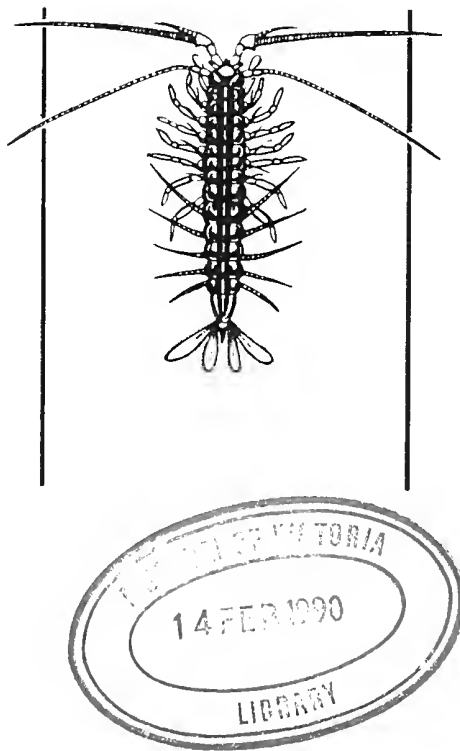


RECORDS OF THE
QUEEN VICTORIA MUSEUM
LAUNCESTON



Edited by
C. B. TASSELL
Director of the Museum

A STUDY OF THE CARYODIDAE (PULMONATA) PART III: SUBSPECIES OF *CARYODES DUFRESNII* (LEACH 1815).

by Ron C. Kershaw

Honorary Research Associate, Queen Victoria Museum and Art Gallery,
Launceston.

Manuscript received 1/11/88

Manuscript published January/89

ABSTRACT

The original figures (Tenison-Woods 1878) of *Caryodes dufresnii superior* Iredale 1937, *Caryodes dufresnii extra* Iredale 1937 and *Caryodes dufresnii dertra* Iredale 1937 are designated as lectotypes. The anatomy of representative specimens is described, the shell variation noted and the type localities defined.

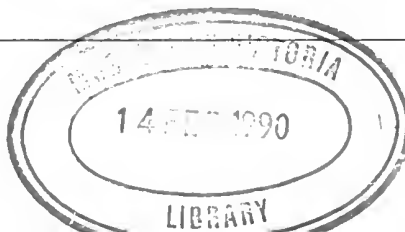
INTRODUCTION

The three subspecific taxa of the endemic Tasmanian land snail *Caryodes dufresnii* (Leach 1815) introduced by Iredale (1937) have hitherto been known only by the designated figures. These figures (Tenison-Woods 1878) were intended to illustrate some of the variation encountered. Because of the range of perceived variation, the possibility that one at least could be extinct and the lack of type material, these taxa have not been given serious consideration. Live material from all three localities involved has now been studied and possible racial differences distinguished.

The three taxa were validly introduced by Iredale (1937) according to the rules of the International Code for 1961 and therefore could not be ignored. The original material from the Legrand collection studied by Tenison-Woods (1878 p.91) was later purchased by C. E. Beddome and dispersed in London after his death. There is no evidence in the Australian Museum that Iredale may have studied appropriate specimens. As additional morphs with distinguishable anatomical characters exist it is necessary to define all existing taxa before these can be dealt with. The gross anatomy of the species *Caryodes dufresnii* (Leach 1815) has been described (Kershaw 1988b). This paper designates the Tenison-Woods (1878) figures (specified by Iredale 1937) as lectotypes as provided for in Article 74(c) of the International Code of Zoological Nomenclature Third Edition of February 1985.

Two of the varieties figured by Tenison-Woods (1878), i.e., those from "Macquarie Harbour" and "Port Davey" exhibit extreme aspects of the variation possible within the genus *Caryodes*. Such variations are very rare in any particular locality. Two of the composite figures specified by Iredale (1937) illustrate different variations of growth stages. Although Iredale provided a brief description favouring one, he may have deliberately specified the whole figure to include variations in each case. As the material studied was found in or near the original localities, it is considered appropriate on this basis.

Aspects of shell variation in the genus *Caryodes* have been discussed by Tenison-Woods (1878) and Kershaw & Dartnall (1972). A comprehensive coverage of this variation is not possible within this study but some discussion of shell characters is necessary in defining the three taxa studied here.



MATERIAL AND METHODS

The dissected specimens, here designated as vouchers, are held in the Tasmanian Museum and Art Gallery (TM). All the other material studied is included in the collections of that Museum or the Queen Victoria Museum and Art Gallery (QVM). Material dissected or measured in addition to that already listed (Kershaw 1988b) is specified in the Appendix (TABLE FIVE).

The methods and criteria used are described in Kershaw (1988a, 1988b).

Caryodes dufresnii superior Iredale 1937.

Lectotype: Figure 4, plate 7 of Tenison-Woods (1878) specified by Iredale (1937).

Type Locality: Macquarie Harbour probably near Strahan. Source of the voucher material: Near the Lyell Highway 3.8 km along the highway east from Strahan and near Macquarie Harbour, western Tasmania; Tasmapi 1: 100 000 Cape Sorell 7913, grid 367000mE.5331600mN. Voucher specimen TM E17695 collected by R. C. and W. M. Kershaw 3-iv-1988

DIAGNOSIS

The shell is large and broad. The voucher is reddish brown with the central (peripheral) band broad, almost black and the adjoining bands yellow, the lower being wider than the upper. The base is black becoming brown near the aperture and basal margin. The aperture is vertically pyriform with the columella vertical and slightly twisted. The dimensions are listed in TABLE ONE.

This animal has a pale brown body, brownish cream foot and pale cream sole but animals vary from cream to brown with the digestive gland and kidney brown. Shell colour varies from reddish brown to yellowish green. The male pore, opening into the apical penis, is transverse in orientation as in the typical subspecies.

Remarks: The criteria for selecting the voucher material requires that it be from the vicinity of Macquarie Harbour and that there should be a resemblance to the lectotype above designated. Iredale (1937) specified "A large shell, broad, deep maroon".

These criteria could not be met fully on two points. The colour deep maroon is very rare. The figure (Tenison-Woods 1878) shows a distinct apical apertural sinus. This extremely rare feature has not been seen by the author. Colour and shape variation is well known in shells of this genus. The typical form from the Macquarie Harbour area is large and broad. Tenison-Woods (l.c) selected an extreme example to illustrate his discussion and hence the sinus is not considered to be significant. The dimensions of comparable shells are listed in TABLE ONE.

The essential features of *C. d. superior* Iredale are considered to be those of a broad dark brown to dark reddish brown shell with a clearly obtuse apex with a habitat in the wet forest of central western Tasmania.

DESCRIPTION

The voucher specimen (TM E17695) (fig.1) has an adult shell of 5.25 whorls, 37 mm height and 22.4 mm width. The corroded obtuse apex has strong visible spiral lirae continuing into the adult. The protoconch ends between 2.6 and 2.75 whorls with an increase in the incidence of radial ridges and grooves. Shells are bulimoid, large, variably broad and obtuse. The adult aperture has the reflected columella only moderately twisted but shells may vary from vertical to oblique. Compared to the typical subspecies the shell is noticeably broader and more convex in outline. A shell from Ewart Creek, Zeehan Highway (TM E8742, fig.2) has a clearly twisted columella.

ANATOMY

The animal is strong and well grown with a well developed muscular system. The foot and body ornament are similar to that found throughout the genus.

The jaw is shallowly arcuate, orange coloured. The radula of 117 rows of strong unicuspid teeth has a formula of 42.12.1.12.42. There are about 26 latero-marginals which are elongate



Figure 1. *Caryodes dufresnii superior* Iredale.

Voucher shell TM E17695 from near Macquarie Harbour, natural height 37 mm.

Figure 2. *Caryodes dufresnii superior*, shell from Ewart Creek, Zeehan Hy. TM E8742, natural height 32.5 mm.

and oblique. The 16 outer marginals are much shorter than the laterals. The central tooth is also small and narrower. All cusps are elongate and there is a distinct ridge across the anterior margin.

The pallial region is elongate with a well developed circulatory system and large heart. The kidney (fig.3) is narrow elongate. The laterally distinct cream coloured primary ureter has its elongate pore opening basally.

Apical Genitalia

The brown ovotestis is indistinct but the visible acini are large. The very long hermaphrodite duct is strongly kinked with mature seminal vesicles and enters the elongate (2.2 mm) hooked talon latero-apically. The carrefour region is embedded in the surface of the elongate (17 mm) cream and orange albumen gland (fig.4).

The Spermoviduct

The developed prostate is deep cream coloured and the uterus greyish cream. Both dissected animals are sexually mature with emphasis on the male phase.

The globular bursa copulatrix is immersed as usual. The bursa duct (fig.4) is short, less than 50% of spermoviduct length but variable. Internally the duct is lined with simple sharpened pilasters.

The bursa duct diverticulum (fig.4) is short, less than 26% of spermoviduct length, with a very narrow pore. The lumen is lined with variable broad irregular simple pilasters (fig.5).

The vagina (fig.5) is relatively long and capacious. There is a narrowly bulging medial pocket. The chamber is lined with bold narrow but variable pilasters which become low simple ridges at the atrium. The short (ca.3 mm) free oviduct is lined with irregular thin pilasters. The bursa duct-vagina junction is short irregular variably defined.

The atrium is very short, less than 2 mm, opening from a relatively inconspicuous gonopore near the right ocular tentacle. The female opening is lateral to the male.

Male Genitalia

The vas deferens (fig.4) is long, (ca. 30 mm with the expanded epiphallus tightly adjacent the penis. It enters the penial wall at between 60 and 70% of the penial length causing the wall to bulge to the male pore near the penial apex (2.6 mm or less). The pore consists of a transverse aperture with a fleshy wall projecting into the lumen. The epiphallus (fig.8) is lined with beaded pilasters which are very short and bold at the pore.

The penis (figs.4,7) is elongate (19 mm) thin subcylindrical slightly inflated tapering to acuminate apically. An internal structure of narrow transverse laminate pilasters forms a composite bulging structure from the apex to the vas deferens insertion. The medial units of this structure become weaker longitudinal. Laterally there are short pilasters making a total number of 30. Pilasters are absent over the vas deferens ridge. Basally there are about 10 long weak pilasters entering the atrium.

The penial retractor (fig.4) is a relatively short stout rounded muscle attaching at between 50% and 69% of the penial length from the atrium adjoining the vas deferens ridge.

Remarks: The internal penial structure differs from that of *C. d. dufresnii* in the absence of strongly fluted pilasters and the different basal, apical and male pore structure. The composite structure is variably widely present although it may be weak in some animals (e.g. a specimen from Hibbs Lagoon). The transverse orientated male pore resembles the typical subspecies but differs in detail. The vagina and diverticulum have a much simpler internal structure.

The penial anatomy of a Magnet Range morph resembles that found in animals from northern Tasmania suggesting that the above subspecies may be confined to the central west.

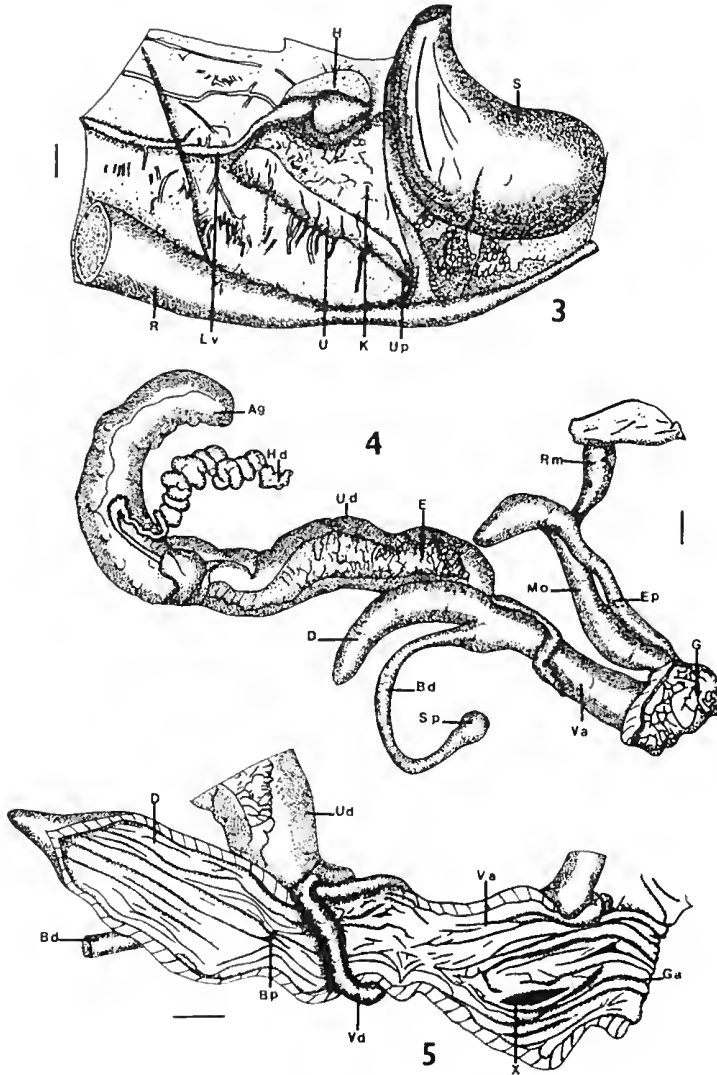


Figure 3. *Caryodes dufresnii superior*, kidney, heart and stomach, scale line 2 mm.

Figure 4. *Caryodes dufresnii superior*, genitalia, scale line 2 mm.

Figure 5. *Caryodes dufresnii superior*, internal structure of the vagina and diverticulum, scale line 2 mm.

Summary of Features

Snails with a large broad shell and obtuse apex. The penis of more than 50% of the vas deferens length has a complex internal structure typically with the pilasters only briefly or not at all fluted and distally the pilasters entering the atrium are weak and long. The transverse male pore is near the penial apex, the penial retractor inserts at less than 70% of the penial length from the atrium, the long vagina and short bursa duct diverticulum have simple internal structure and the bursa duct is short.

THE TYPE LOCALITY

The locality 'Macquarie Harbour' (Iredale 1937) is defined as that region near Strahan bounded by 42°05'S to 42°12'S and 145°20'E to 145°27'E. This region is largely within State Forest north of Macquarie Harbour and the King River (Tasmap Cape Sorell 7913). The region is chosen as that most likely to have been the source of the lectotype. Hydro-electric storage development renders some areas to the south undesirable. Shells from the region resemble the type figure despite the absence of an apertural sinus.

The Habitat

The voucher specimen was collected in a deep litter of eucalypt leaves and twigs on a moderate slope in wet sclerophyll forest. The environment, north of the Lyell Highway near Teepookana, includes both sclerophyll and rainforest.

The vegetation includes *Eucalyptus nitida* (dominant), *Leptospermum scoparium*, *Acacia verticillata*, *Phebalium squameum*, *Coprosma quadrifida*, *Lomandra longifolia*, *Dianella tasmanica* and *Pteridium esculentum*. One specimen of *Nothofagus cunninghamii* was noticed near the roadside. The litter has accumulated beneath the eucalypts on a relatively open surface. Areas of reduced slope and drainage have a variably dense fern cover. The canopy is dense.

Geology and Soils

The geology of the Queenstown region is described by Corbett and Brown (1976). The type locality bedrock is Palaeozoic. The voucher specimen was collected on soils developed on Cambrian sediments. A narrow band of granitic bedrock occurs immediately to the north. A sequence near Teepookana has been described (l.c.1976,p.11).

There is a shallow humus clay loam A horizon over yellow clay which is visible in outcrop adjacent the highway. Nicolls and Dimmock (1965) describe the soils as mainly gradational profiles. The land systems of the type locality (Richley 1978) include parts of the Pieman River, Jessie River, Tully River and Zeehan systems.

Climate

The average annual rainfall at the Queenstown station (Bureau of Meteorology 1985) is 2,526 mm. The mean summer temperature for 1983 varied from 8.3°C to 20.1°C and the winter mean from 3.3°C to 12°C.

Remarks: The specimens from the east end of Hibbs Lagoon were collected in a wet gully. The vegetation also included *Eucalyptus nitida*, *Coprosma quadrifida* and *Blechnum wattsii*, but with various alternative or additional species such as *Leptospermum glaucescens*, *Cennarhenes nitida* and *Gahnia grandis*.

Caryodes dufresnii extra Iredale 1937.

Lectotype: Figure 3b, plate 7 of Tenison-Woods (1878) specified by Iredale (1937).

Type Locality: Port Davey.

Source of the Voucher material: South of Fowlers Point, Port Davey near the coast between Kelly Basin and Payne Bay, western Tasmania; Tasmap 1: 100 000 Port Davey 8011, grid 412700mE 5207900mN; voucher specimen TM E17694 supplied by S. Smith, collected 13-11-1987 in a eucalypt bole.

DIAGNOSIS

The shell is large, honey brown, to very dark on the base and fourth whorl. The central (peripheral) band is reddish very dark brown, the lateral bands are yellow, the lower being the widest. The aperture is pyriform, the columella almost vertical and nearly straight.

The animal is pale brownish with a pale cream foot sole. The digestive gland and kidney are brown. The male pore, opening into the apical penis, is transverse in orientation.

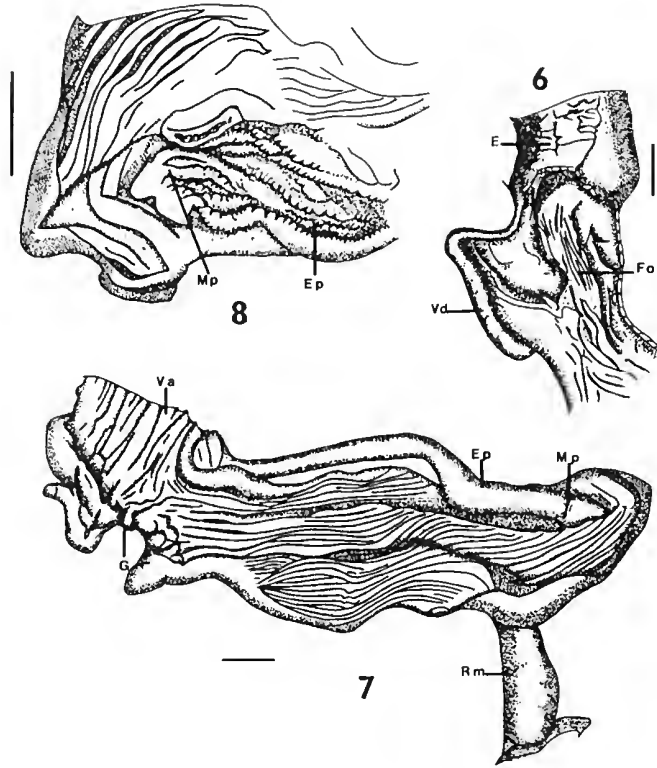


Figure 6. *Caryodes dufresnii superior*, internal structure of the free oviduct, scale line 2 mm.

Figure 7. *Caryodes dufresnii superior*, internal structure of the penis, scale line 2 mm.

Figure 8. *Caryodes dufresnii superior*, internal structure of the epiphallus, scale line 2 mm.

Remarks: The voucher was the only specimen from the type locality having an animal for dissection. Iredale (1937) described the shell as "Large and narrow with the columella nearly straight".

The voucher most resembles figure 3a (Tenison-Woods 1878). The aperture features are similar to both figures 3a and 3b. A shell from Settlement Point, Davey River (TM E13073, fig.9) is broad with a somewhat oval aperture but otherwise resembles figure 3b. A shell from Maatsuyker Island (TM E7949, fig.10) is narrow, resembling figure 3a with an oblique aperture. A shell from a Stephens Bay midden near Port Davey (fig.11) is also narrow with a narrow apex. A Port Davey shell (fig.12) is ovoid. In each case the columella is straight.

Shells as narrow as figure 3b on which Iredale clearly based his selection are rare and scattered throughout Tasmania. Iredale even draws attention to such a shell from Ringarooma (Tenison-Woods 1878, fig.6b). Another narrow shell is known from Forestier Peninsula. Nevertheless the shell of figure 3b is exceptional and a closely comparable example has not been found. The obvious features of a racial form based on this shell are the almost straight columella and the narrow spire. However, *Caryodes dufresnii dufresnii* (Leach) has a narrow spire and a straight columella is present in shells from Maydena and Russell River. Of two Kelly Basin shells (TM E2320) one has the columella almost straight and the other is twisted and curved.

The aperture in genus *Caryodes* is very variable with oblique and vertical shapes present in the same population. Certainly the almost straight columella seems more common among shells known from the Port Davey area and thus differs from the typically twisted and curved columella of the type subspecies. TABLE TWO lists the dimensions of shells comparable with *C. d. extra lredale*.

DESCRIPTION

The voucher specimen (TM E17694, fig.14) has a near adult shell of 5.25 whorls, 34.3 mm height and 19.5 mm width. The protoconch sculpture (TM E2348, fig.13) is of distinct narrow spiral riblets, about 20 near the start of the second whorl and increasing in number with about four slightly bolder. There are nodular projections just below the suture and grooves between these extend further down the whorl with growth.

Irregular radial ridges at the end of the protoconch develop into distinct low close radial riblets in the adult. At the suture there are raised ridges which are a compound of the close riblets. The continuing spirals produce granular rounded postular segments on the third whorl which are very weak by the fourth and although the spirals remain visible radial ridges dominate. The aperture is pyriform, the margins thickened, the columella narrowly reflected, slightly twisted, almost vertical and straight, the rounded base not broad.

This form differs from *C. d. superior* in the dense raised nodular ridges below the suture and the sub-acute apex. Compared with *C. d. dufresnii* the bold protoconch riblets are continuous rather than segmented.

ANATOMY

The foot, body ornament and general features of the dissected animal resemble those of the type subspecies. The digestive gland is brown, the kidney pale brown and elongate. The distinct cream coloured primary ureter has its pore opening at the base.

The radula has 164 rows with 101 unicuspid teeth per row having a formula of 40.10.1.10.40. The teeth are similar to those of the type subspecies but the central tooth is broader, compressed medially and has transverse ridges anteriorly. The marginals are elongate, slightly curved and pointed. Some teeth can be seen to be notched under the optical microscope but the cause is uncertain.

Apical Genitalia

There is no distinguishable difference between this and the type subspecies. The ovotestis is figured by Kershaw (1988b). The globular bursa is immersed as usual. The bursa duct is long (fig.15), less than 70% of the spermooviduct length with an internal structure of low rounded transversely cut pilasters.

The bursa duct diverticulum (fig.16) is of medium length, almost 50% of the spermooviduct length and basally somewhat coiled to the narrow pore. It is fleshy within and lined with a complex structure of low rounded transversely cut pilasters which amalgamate to become sharp, short and bold at the pore.

The free oviduct is short (about 2 mm) and lined with six very low, thin, close, ridges.

The vagina (fig.16) is relatively long with complex internal structure. There is a large compound pilaster adjacent the atrium and a series of very complex pilasters within the capacious lumen. The junction between the vagina and bursa duct appears to be abrupt with a rapid change in structure adjacent the free oviduct pore.

The atrium is very short and lined with defined ridges to the gonopore.

Male Genitalia

The vas deferens (fig.15) is long (ca. 30 mm) with the distinct epiphallus tightly adjacent to and entering the penis wall at about 63% of the length from the atrium. The transversely

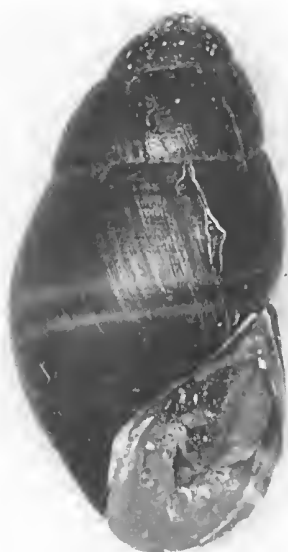


Figure 9. *Caryodes dufresnii extra* Iredale. A striped variation with a vertical aperture and slightly twisted vertical columella from Settlement Point, TM E13073, natural height 32 mm.

Figure 10. *Caryodes dufresnii extra*. (?) An elongate variation from Maatsuyker Island, TM E7949, natural height 29.4 mm.

Figure 11. *Caryodes dufresnii extra*. A narrow elongate variation with a straight vertical columella which coils into the body; from Stephens Bay QVM 1988/9/550, natural height 33.6 mm.

Figure 12. *Caryodes dufresnii extra*. A broad variation with a broad aperture and straight vertical columella having no visible coil; from Port Davey, QVM 1988/9/551, natural height 33.9 mm.

orientated male pore enters the lumen 4.5 mm away from the apex (ca.22.5% of penial length). There is a high strongly beaded longitudinal pilaster which arises well within the epiphallus and leads to the pore. The ridges are low beaded prior to and adjacent this pilaster (fig.17).

The penis (fig.18) is elongate (ca.20 mm) subcylindrical, tapering apically. The internal structure is complex with 10 of the apical to medial pilasters transverse and the remainder longitudinal with strongly fluted sides giving the interstices a zig zag appearance. Medially to basally the number reduces from 24 to 10 rapidly with 4 or 5 short distal pilasters entering the atrium. Apically 16 pilasters converge into the acuminate apex. The ridge of the vas deferens is marked with a few fine lines.

The penial retractor (fig.15) is short and thin attaching at between 50% and 69% of the penial length from the atrium distinctly separated from the vas deferens ridge.

Remarks: This morph differs from the typical subspecies in the distance of the male pore from the penial apex and the length of the vagina. Apart from the shell features there is very little to separate the two forms which the author has hitherto considered to be synonymous. More dissections, enabling a detailed study of the male pore, are required to determine the validity of the taxon.

Summary of Features

Snails with a large comparatively narrow shell. The penis of more than 50% of the vas deferens length has a complex internal structure, a distinct proportion of the pilasters with fluted sides, a few short pilasters enter the atrium, the transverse male pore not at or near the penial apex and the penial retractor inserted at less than 70% of the penial length from the atrium. The comparatively long vagina and the medium length diverticulum have complex structure and the bursa duct is long.

THE TYPE LOCALITY

The locality "Port Davey" (Iredale 1937) is defined as that region bounded by 43°10'S to 43°21'S and 145°49'E to 146°19'E. The region is chosen as inclusive of a large proportion of land surface in the vicinity of Port Davey (Tasmap Port Davey 8011) inclusive of Kelly Basin and Settlement Point (sites of known specimens) and the locality of the dissected voucher.

The Habitat

The vegetation in the vicinity of the voucher specimen locality at Fowlers Point is most probably wet scrub dominated by *Leptospermum* spp. and *Melaleuca squarrosa* with emergent *Eucalyptus nitida*. The eucalypt bole in which the specimen was found was most likely of the latter species. A range of tree species is recorded from the Port Davey region by Kirkpatrick and Backhouse (1983).

Geology and Soils

The geology of the Port Davey region is described by Williams and Corbett (1977). The type locality is dominated by Precambrian metamorphic rocks. There are also significant areas of Holocene sands bordering Kelly Basin, White Horse Plain, Stephens Bay and elsewhere. The soils are described as skeletal on steep slopes and moor podzol peats on lower slopes and valley floors (Nicholls and Dimmock 1965).

Climate

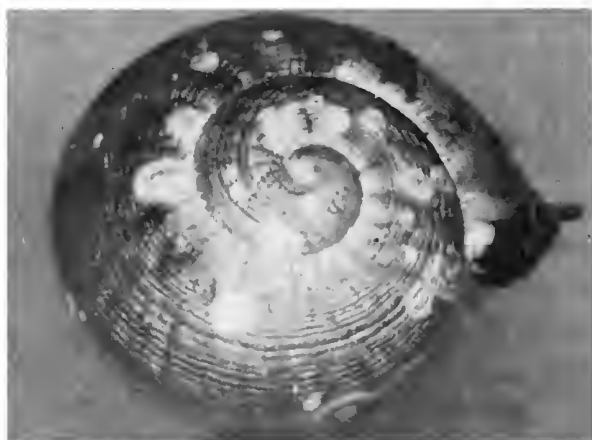
The available climatic data are discussed by Kershaw (1987, pp.59,68).

Caryodes dufresnii dertra Iredale 1937.

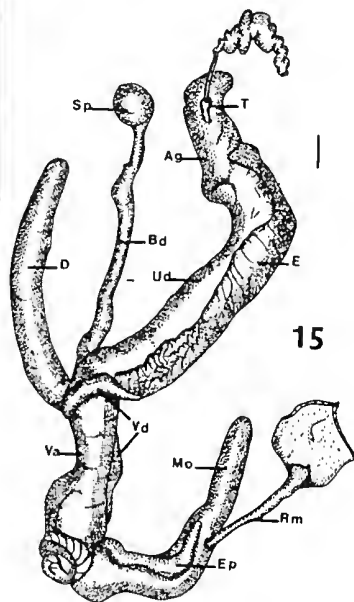
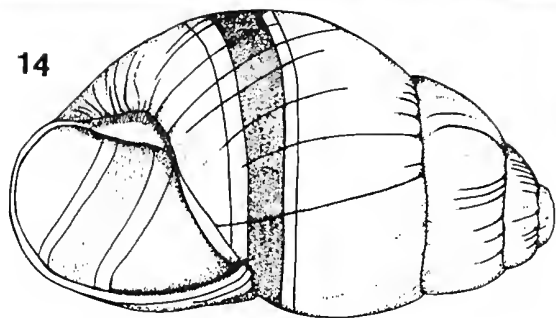
Lectotype: Figure 2c, plate 7 of Tenison-Woods (1878) specified by Iredale (1937).

Type Locality: Launceston, St. Leonards.

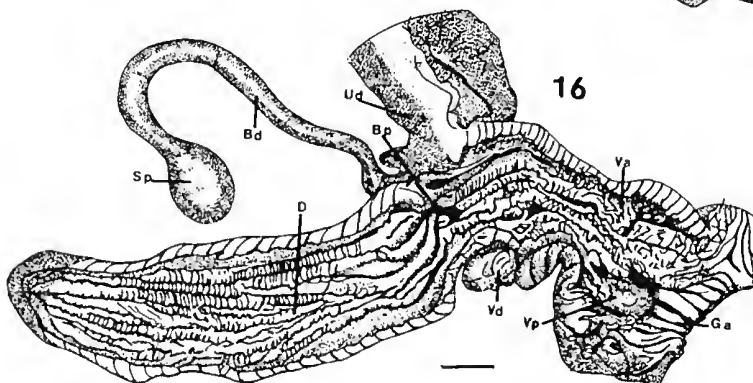
Source of the Voucher material: Prossers Forest between St. Leonards and Patersonia, northern



14



15



16

Figure 13. *Caryodes dufresnii extra*. A juvenile discoid shell showing the protoconch sculpture from Port Davey, TM E2348, diameter 7 mm at 2.6 whorls.

Figure 14. *Caryodes dufresnii extra*. A drawing of the voucher from Fowlers Point, Port Davey, TM E17694, natural height 34.3 mm.

Figure 15. *Caryodes dufresnii extra*, genitalia, scale line 2 mm.

Figure 16. *Caryodes dufresnii extra*, internal structure of the vagina and diverticulum, scale line 2 mm.

Tasmania; Tasmap 1: 100 000 Pipers 8315, grid 516400mE. 5424100mN. Voucher TM E17693 collected by R. C. & W. M. Kershaw 27-ix-1986.

DIAGNOSIS

"At Launceston the shells are smaller, though elongate in shape, and with the columella notably twisted" (Iredale 1937). The voucher locality shells are light brown to brown having a yellowish pale orange base and 5 peripheral bands. The bands are alternately coloured very dark brown and yellowish pale orange, vary in width and reddish tints may be present. The apex is acute or subacute, the columella almost vertical and twisting is variably distinct. The dimensions are listed in TABLE THREE.

The animal is cream, the foot margin greyish cream with the foot sole paler. The colour varies with the extent of grey tint present. The digestive gland is bright brown. The male pore, opening into the apical penis, is longitudinal in orientation.

Remarks: Iredale (1937) specified figure 2 but figure 2c is here designated as it is a mature specimen. The figures show variations in band number, shell width and obliquity of the aperture. These variations were normal in Tamar Valley and adjoining populations (fig. 21). Shell width varies both in adult shells and in growth stages. Because of the body whorl size adult shells appear very different when compared to a juvenile of the same population. While typically pale in colour shells vary from yellow to brown. Specimens from George Town collected by Petterd (TM E8273) are distinctly yellow and pale brown examples also exist. Although a twisted columella is not unusual in the genus it is typical of this morph as noticed by Iredale. The dimensions of comparable shells are listed in TABLE THREE.

The typical shell of this subspecies is therefore thin, typically light coloured with few or many peripheral bands, the spire sloping to an acute or subacute apex and the columella distinctly twisted (fig.19). Its habitat is dry sclerophyll forest and woodland of the Tamar Valley near Launceston which included the Cataract Gorge. It is now almost extinct in this form.

DESCRIPTION

The voucher specimen (TM E17693, fig.20) is subadult. It has a shell of 5 whorls, 24.6 mm in height and 15.5 mm in diameter. The apex is near acute, the diameter comparatively broad and the texture thin. The fine distinct protoconch sculpture increases from 12 or more spiral lirae on the first whorl to very many thinner lirae which have the appearance of groups separated by a distinct thin spiral groove at intervals. The lirae are all cut radially into elongate segments by irregular grooves. The protoconch ends at between 2.3 and 2.5 whorls where the grooves are deeper, very irregular ridges appear and the whorl expands rapidly with growth. The radial ridges become riblets at the suture although less obvious below, the spiral segments are small, the sculpture reticulate but fading with growth and the radial riblets become low riblets fading towards the periphery.

The aperture is subquadrate, the outer margin slightly thickened subadult, the columella almost vertical, distinctly but not broadly twisted and the base rounded. The extent of twisting varies among the eight shells from the voucher locality. Compared with the typical subspecies the shell is thin, small, the sculpture finer, the subsutural ridges much thinner and closer. The apex is more acute and the colours are typically pale.

ANATOMY

The greyish cream foot has weak tail surface ornament but clear rounded elongate tubercles appear on the neck, anterior flank and muzzle. The shell colour bands are seen on the animal's collar but in this example the paler bands are seen as white bands about the body.

The pallial region (fig.23) is noticeably elongate with a strong principal pulmonary vein. The heart extends laterally along three quarters of the kidney flank. The kidney is almost oblong elongate with the pale clear primary ureter having its pore at the base as usual. The intestine extends from the stomach in an elongate narrow loop to the kidney base. The pallial region appearance is thus more strongly compressed than is found in the wet forest morphs.

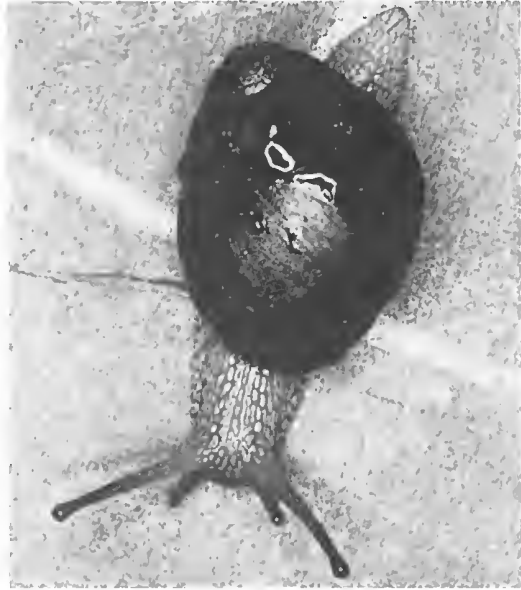
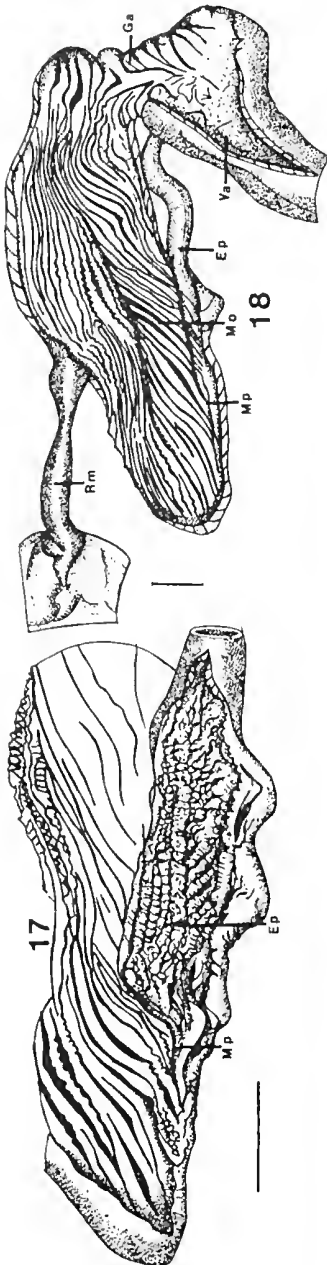


Figure 17. *Caryodes dufresnii extra*, internal structure of the epiphallus, scale line 2 mm.

Figure 18. *Caryodes dufresnii extra*, internal structure of the penis, scale line 2mm

Figure 19. *Caryodes dufresnii dertra* Iredale. A shell from Cataract Hill, Launceston, TM E914 (Petterd), natural height 19.5 mm.

Figure 20. *Caryodes dufresnii dertra*. The voucher specimen from Prossers Forest, TM E17693, natural height 24.6 mm.

The oesophagus and salivary gland are compressed between the penis and spermoviduct with the gland extending through the circumoesophageal ganglionic ring on to the buccal mass. The cerebral ganglia are large and clearly visible and the muscular system well developed.

The jaw is strongly arcuate, narrow and deep orange-brown in front fading to pale orange below. It is sculptured with two or three longitudinal and several transverse grooves.

The radula has 130 rows of unicuspid teeth with formula of 36.9.1.9.36. The central tooth is very narrow elongate with a distinct central longitudinal ridge and is distinctly smaller than the laterals. The first laterals display lateral protrusions suggesting stumps of a tricuspid form not apparent in the marginals; the marginal teeth are elongate with the inner marginals almost dumbbell shape. The outer marginals are somewhat produced anteriorly.

These teeth differ in size and shape compared to the other subspecies. Some features may be artifacts of the optical microscope and a more detailed study is warranted.

Apical Genitalia

The pale ovotestis is embedded in the bright brown digestive gland with the developing hermaphrodite duct cream and clearly kinked with seminal vesicles for two thirds of its length. The albumen gland is elongate, orange coloured and well developed. The carrefour configuration is generic although the talon appears elongate (fig.23).

The Spermoviduct

The genital ducts (fig.23) are slightly immature with the prostate thin and pale cream and the uterus pale cream. The very short free oviduct is lined with broad low ridges which appear to become briefly very narrow.

The bursa copulatrix (fig.23) is subglobular slightly elongate. The bursa duct is long (ca.13 mm), about 57% of the spermoviduct length and lined with narrow pilasters which are more or less continuous into the vagina.

The bursa duct diverticulum (figs. 23,24) is short, curved with a broad base. Internally, broad fleshy pilasters rise to form sharp ridges but one is broader and rounded.

The vagina (fig.24) is relatively long, more than 20% of the spermoviduct length. The chamber is lined with simple longitudinal narrow rounded pilasters, weak in the bursa duct-vagina junction area but one is continuous. There is a medial pocket containing a small but prominent pilaster pad.

The atrium (fig.24) is very short, about 1 mm, with narrow pilasters continuous from the genital lumina.

The Male Genitalia

The vas deferens (fig.23) is short (ca.16 mm). The distinct epiphallus adjacent the penis, enters the penial wall at about 60% of the length from the atrium.

The male pore is longitudinal in orientation and enters the penial lumen at 0.9 mm or 10% of the penial length from the apex, i.e. it is at the apex. A bold pilaster emerges from the slit-like pore (fig.25). Internally the epiphallic structure consists of longitudinal ridges of bold rounded beads which are obliquely transverse some 3 mm within.

The penis (figs.23,26) is small (ca.9 mm), inflated, thin basally, acuminate apically. The lumen contains high, close, narrowly rounded, laminate pilasters. Medially, about 20 combine, their interstices ending abruptly, to reduce to the few long basal pilasters entering the atrium.

The penial retractor (fig.23) is very broad, short and very stout. It attaches away from the vas deferens ridge at about 66% of the penial length from the atrium.

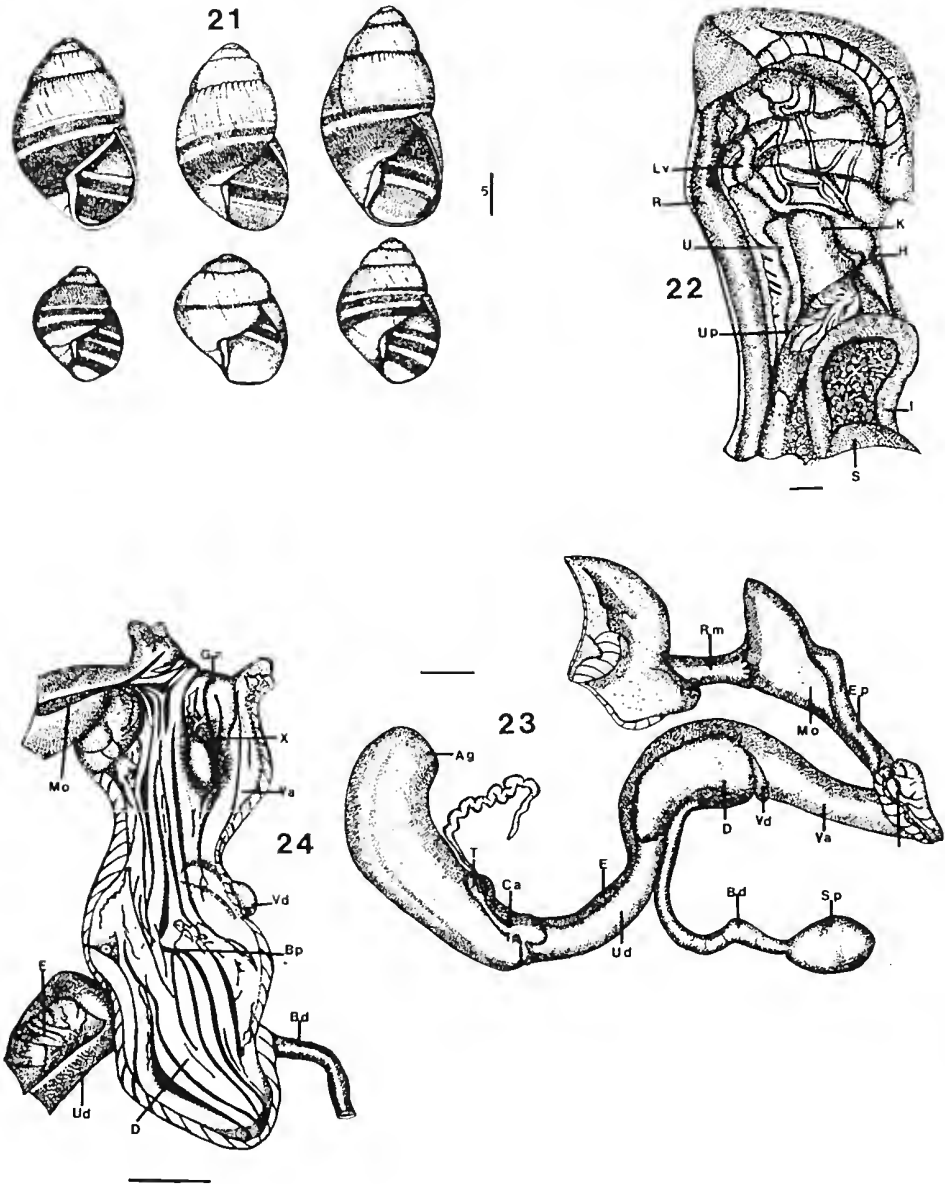


Figure 21. *Caryodes dufresnii dertra*. Six shells from an extinct population from Windermere near Launceston showing aperture and diameter variation, QVM1988/9/552.

Figure 22. *Caryodes dufresnii dertra*. The pallial region showing kidney, heart and elongate loop of the intestine, scale line 2 mm.

Figure 23. *Caryodes dufresnii dertra*, genitalia, scale line 2 mm.

Figure 24. *Caryodes dufresnii dertra*, internal structure of the vagina and diverticulum, scale line 2 mm.

Summary of Features

The small thin shells have an acutely tapering spire and a twisted columella. The penis is short, about 50% of the vas deferens length and has a complex internal structure, a few long distal pilasters entering the atrium, the male pore a longitudinal slit at the apex, the penial retractor attached at between 50 and 69% of the penial length from the atrium. The long vagina and short diverticulum have simple internal structure and the bursa duct is very long.

Remarks: The voucher locality for this subspecies has since been fire damaged and no further specimens could be found. However the anatomy of morphs from Underwood (QVM1988/9/40), The Glen (QVM1988/9/41) and Sideling Range (QVM1988/9/563), localities fringing Mt. Arthur, is similar. The genitalia of the Underwood animal closely resembles the subspecies as described but the Glen animal differs slightly. Although distinctly different in size and colour all these eucalypt forest dwellers may be grouped with this subspecies on the basis of their anatomy. The genitalia of the Mt. Arthur animal (QVM1988/9/53) is different and resembles that of Mt. Barrow animals (QVM1988/9/562).

The Spermatophore

The vas deferens of snails of genus *Caryodes* is expanded moderately from the base of the penis to the male pore. The writer has observed (1988b) differences in the internal structural complexity between this apparent epiphallus and the proximal vas deferens. However clear evidence of a spermatophore seemed absent.

During dissections to establish the distribution of *C. d. dertra* Iredale two ovoid capsules of dimensions 4.5 mm x 3 mm and 5 mm x 3 mm were found within the bursa copulatrix of the Underwood animal. Cream coloured strings of sperm very similar in appearance to that found in the seminal vesicles were seen within a mucous fluid visible through the transparent envelope. Similar capsules were present within the bursa copulatrix of The Glen animal and a compact mass filled the bursa duct and bursa duct diverticulum. Capsules retaining recognizable form exhibited a pink spot at one end. There is no horny case.

THE TYPE LOCALITY

The locality "Launceston" Iredale (1937) is defined as that region bounded by 41°20'S to 41°28'S and 147°10'E to 147°16'E to the north of the City of Launceston between St. Leonards and Patersonia. The region is chosen as inclusive of St. Leonards (now suburban), the source of the specimen illustrated by Tenison-Woods (1878, fig. 2C) and Prossers Forest, the source of the dissected voucher specimen. This forest is the nearest surviving habitat and includes an area of State Forest.

The Habitat

The voucher specimen was collected from under eucalypt bark on a moderate slope adjacent a wet drainage line. A search among the ferns did not reveal specimens on this wet line. However further specimens were found on a steep grassy slope in open woodland in litter adjacent logs and below the eucalypt trees.

Observed vegetation included: *Eucalyptus obliqua*, *E. amygdalina*, occasional *E. delegatensis*, *Allocasuarina littoralis*, *Leptospermum lanigerum*, *L. scoparium*, *Acacia verticillata*, *A. dealbata*, *A. melanoxylon*, *A. genistifolia*, *Banksia marginata*, *Pomaderris apetala*, *Cassinia aculeata*, *Exocarpus cupressiformis*, *Lomatia tinctoria*, *Leptomeria drupacea*, *Epacris impressa*, *Gahnia grandis*, *Juncus pallidus*, *Lepidosperma concava*, *Lomandra longifolia*, *Styphelia humifusa*, *Acaena anserinifolia*, *Thermeda australis*, *Senecio linearifolius*, *Platylobium formosum*, *Dianella tasmanica*, *Billardiera scandens*, *Pteridium esculentum*, blackberry and *Erica*. The sites differed more in terms of distribution than species composition. However adjacent the voucher site there were *Polystichum proliferum* and *Melaleuca ericifolia* probably due to the variable drainage. *Allocasuarina littoralis* was not seen at this site.

The slopes were dominated by eucalypts with scattered low understorey trees and

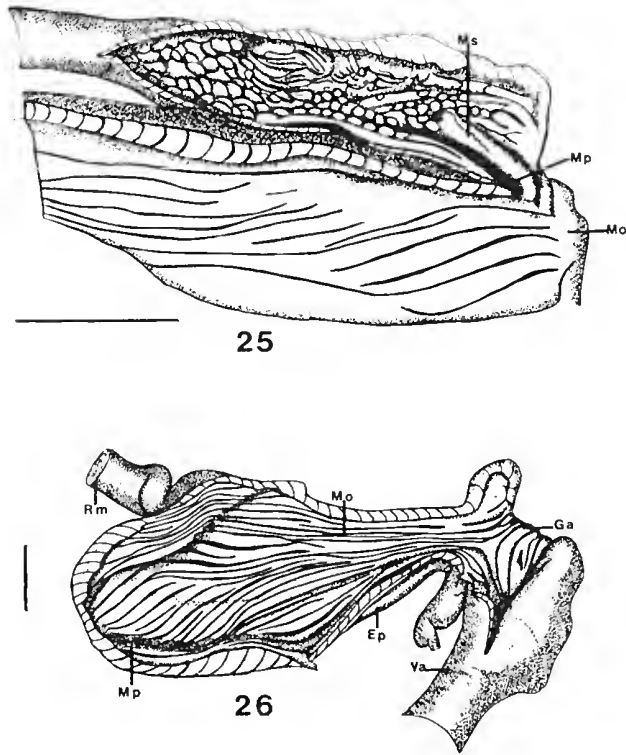


Figure 25. *Caryodes dufresnii* dertra, internal structure of the epiphallus, scale line 2 mm.
Figure 26. *Caryodes dufresnii* dertra, internal structure of the penis, scale line 2 mm.

occasional shrubs. The increased shrub growth on the lower slopes to the flats forms a dense scrub in moist areas. The subspecies was found only at two sites of the many searched. Other snail species observed included *Cystopelta petterdi* and *Helicarion cuvieri*.

Geology and Soils

The geology is described by McClenaghan & Baillie (1975). Dolerite outcrops dominate the slopes and much scattered stone and slabs provide shelter for invertebrates. Sheets of colluvium are present on the flats forming pale soils with a low humus level. The soils of slopes are mainly shallow grey brown podzolic widespread in the area (Nicolls & Dimmock 1965). The land systems (Pinkard 1980) included the Prossers Forest System on low dolerite hills, the Eagle Hawk Tier System on dolerite hills and a small area of the Berkley System on Tertiary Basalt.

Climate

The climatic data are similar to those provided by Kershaw (1987). The Prossers Forest land system has an average rainfall of 1000-1250 mm per annum (Pinkard 1980). The rainfall at Underwood is within that bracket while that at The Glen is lower. Specimens found in these latter two localities were within favourable drainage lines. There appears no other obvious advantage.

SUBSPECIES MORPHOLOGY

There are a number of races within the genus *Caryodes* in Tasmania. The taxonomic status of these has still to be determined but it is possible that subspecific status may be justified in some cases. There are some races which have morphologically distinct populations based on the shell. An example of this phenomenon is *Caryodes d. dertra* Iredale which apparently has both small, relatively fragile shells, living in a dry habitat and large strong shells living in a wetter habitat. Another possible example of this is found on Maria Island where a small and a large form having factors of anatomical resemblance, live in different habitats.

Therefore the arbitrary division of populations on a size basis fails without study of the anatomy. Similarly the same result follows a division based on variation such as that used by Iredale (1937). Nevertheless because of the numerous possibilities two of Iredale's subspecies can be considered to have some taxonomic value.

Thus the average Tamar Valley shell preserved in existing collections is similar to the shell upon which Iredale based his *C. d. dertra* (Tenison-Woods 1878 fig.2c) but broader, may not have an oblique aperture and the spire is variably acute. As in the case of the Port Davey *C. d. extra* the example chosen seems the extreme and the variation range is not defined. All the known populations vary from narrow to broad specimens having a columella varying from vertical to oblique, twisted or straight. There are examples which present a consistent array of shell characteristics however, and in these populations such variations may be indicative of dominant racial characteristics.

The most common *C. d. dertra* form is usually a pale small, thin, acuminate shell with a twisted columella. In comparing these, now extinct, examples with populations of small forms living elsewhere a small shell of thick texture, bold sculpture, acuminate spire and dark colour becomes obvious. These again contrast strongly with the typical *C. dufresnii* morphology of large strong shells having a sloping spire, subacute apex and dark colour. The extent to which shell morphology has value in racial recognition is uncertain due to the apparent random expression of the variation. Hence extinct populations known only from shells may depend on locality if precise recognition is necessary.

The 'broad shell' morphology considered to be typical of shells found near Macquarie Harbour for which Iredale (1937) erected the taxon *C. d. superior* (fig.4, Tenison-Woods 1878) is not wholly consistent. Shells from near Strahan in the Lodder Collection (QVM1988/9/555) include both broad and narrow examples. The anatomy of specimens from Hibbs Lagoon (QVM1988/9/43) south of Macquarie Harbour, supports the allocation of these broad shells within *C. d. superior* despite some penial resemblance to the Port Davey form. There are also broad shells from the Crotty River bank (QVM1988/9/564) south of Queenstown but the anatomy proved too juvenile for accurate determination.

Shells from the Magnet Range (QVM1988/9/56), to the north of Strahan, also have a broad form. They are of large size and the variation range appears to fit within that of shells found near Strahan. However the anatomy clearly places the animals with northern snails from Mt. Arthur (QVM1988/9/53), Mt. Barrow (QVM1988/9/562) and South Sister (QVM1988/9/553 (near St. Marys). There is even a resemblance to the anatomy of the Mt. Maria snail (QVM1988/9/557) despite essentially different racial characteristics. Another example of this problem of superficial resemblance is seen in a shell from near Whyte River (TM E8746). The dimensions of these shells are compared in TABLE ONE.

Relationships

A comparative study of the available anatomical data reveals the expected presence of basic features which are considered characteristic of the genus (unpublished data). These include the general shell form, banding pattern and characteristics resulting from the evolution and growth of the shell. Thus the aperture changes in shape with growth in such a manner that evolution from a discoid shell is suggested. Similar variations in diameter are present within

populations and within caryodid species but not including *Anoglypta launcestonensis* which appears relatively stable. Populations and species appear to vary through the range in parallel. If so this may be a cause of confusion in determining the status of taxa using shell features.

In the case of *C. d. dertra* Iredale the Underwood population differs from the Prossers Forest population in the larger size (TABLE FOUR), shell colour, aspects of pallial structure and a small increase in the distance of the male pore from the penial apex. The pallial organs are much less compressed and the intestinal loop is not so elongate. Pallial adjustments in the Prossers Forest snail (TM E17693) could be expected in an animal adjusting to a small shell while retaining maximum lung capacity. The Glen animal (QVM1988/9/41) differs further in having a more complex internal diverticulum structure. Just why this should be the case is unknown.

The apparent dual shell morphology suggests that a hypothetical ancestor, having survived the Pleistocene climates, may have adapted to environments favouring populations of either small thin or large strong shells.

The Maria Island situation appears to support some such hypothesis also. The Mt. Maria shell is large but the related drier coastal environment shell (QVM1988/9/556) is small. Again the large Bruny Island snail (QVM1988/9/49) apparently is closely related to a small shelled snail from Esperance (QVM1988/9/55) although these snails are isolated by the sea (Kershaw unpublished). The anatomy reveals an apparent path of derivation not revealed by the shell. The anatomy and the shell-habitat relationship in all the surviving populations should be understood before the distribution and status of potential subspecies can be determined.

SUMMARY

Iredale (1937) introduced three new subspecific taxa within the genus *Caryodes*. Study of the anatomy has shown that the status of two of these, *C. d. superior* Iredale and *C. d. dertra* Iredale has some taxonomic basis but the third, *C. d. extra* Iredale is regarded as a subjective synonym of *C. d. dufresnii* (Leach 1815).

The study indicates that intraspecific relationship and taxonomic decisions based on shell morphology alone are not sufficient due to the variation range.

ACKNOWLEDGEMENTS

Thanks are due to Dr. Steven Smith, Jayne Wells and John Davies (Dept. of Lands, Parks & Wildlife), Miss A. Green and Mrs. E. Turner (Tasmanian Museum & Art Gallery), Dr. R. H. Green, Messrs C. B. Tassell, I. Norton and Mrs. M. P. Cameron (Queen Victoria Museum & Art Gallery), Dr. R. Mesibov and my wife for special help. Mrs M. Johnston (Coles Bay), Messrs C. Spry (Maria Is.) and J. Campbell (Launceston) provided specimens. I thank the Trustees of the Science and Industry Endowment fund for their continued support.

REFERENCES

- Bureau of Meteorology, 1985. Climate in Tasmania. In Cocking, G. D. (Ed.): *Tasmanian Year Book*. Government Printer Hobart: 34-47.
- Corbett, K. D., 1983. Geological Atlas 1:250 000 Series. Sheet SK-55/5. Queenstown. *Explan.Rept.geol.Surv.Tasm.*: 1-19.
- Iredale, T., 1937. A basic list of the land Mollusca of Australia. Part 2. *Aust.Zool.*, 9(1): 1-39.
- Kershaw, R. C. 1987. Type localities for six species of Tasmanian land molluscs (Pulmonata: Stylommatophora) *Pap.Proc.R. Soc.Tasm.*, 121: 57-68.
- Kershaw, R. C. 1988a. A study of the Caryodidae (Pulmonata) Part 1. *Anoglypta launcestonensis* (Reeve 1853). *Rec.Queen Vict.Mus. No. 93*: 1-24.
- Kershaw, R. C., 1988b. A study of the Caryodidae (Pulmonata) Part II. *Caryodes dufresnii* (Leach 1815) *Rec.Queen Vict.Mus. No. 94*: 1-27.
- Kershaw, R. C. & Dartnall, A. J., 1972. The mollusc *Caryodes dufresnii* in Tasmania. *Vict.Nat.*, 89(4): 111-118.

- Kirkpatrick, J. B. & Backhouse, S., 1985 *Native Trees Of Tasmania*. Sue Backhouse, Hobart: 1-135.
- McClenaghan, M. & Baillie, P. W., 1975. Geological Atlas 1:250 000 Series. Sheet SK-55/4. Launceston. *Explan.Rept.geol.Surv.Tasm.*: 1-15.
- Nicholls, K. D. & Dimmock, G. M., 1965. Soils. In Davies, J. L. (Ed.) *Atlas Of Tasmania*. Lands and Surveys Department. Hobart: 26-29.
- Pinkard, G. J., 1980. *Land Systems of Tasmania*. Region 4. Tasmania Department of Agriculture. Hobart: 278pp.
- Richley, L. R., 1978. *Land Systems Of Tasmania*. Region 3. Tasmania Department of Agriculture. Hobart.
- Tenison-Woods, J. E., 1878. On *Bulimus dufresnii*. *Proc.Linn.Soc.N.S.W.*,3(2): 81-91.
- Williams, P. R. & Corbett, E. B., 1977. Geological Atlas 1:250 000 Series. Sheet SK-55/7. Port Davey. *Explan.Rept.geol.Surv.Tasm.*: 1-14.

APPENDIX

Abbreviations used in the Tables: Dimensions and Ratios.

AD—aperture diameter. AH—aperture height. SD—shell diameter. SH—shell height.

WN—whorl number. AHD—aperture height/diameter. ASH—aperture/shell height.

SHD—shell height/diameter. WSH—whorl number/shell height.

TABLE ONE

Caryodes dufresnii superior: comparative dimensions.

	Shell				Aperture				
	WN	SH	SD	SHD	WSH	AH	AD	AHD	ASH
Woods Figure 4	5.0	34.0	20.0	0.59	0.15	18.0	11.3	0.63	0.53
Strahan									
TM E17695	5.2	37.0	22.4	0.61	0.14	18.4	12.4	0.67	0.50
QVM1988/9/42	5.3	36.8	20.8	0.57	0.15	18.0	10.4	0.58	0.49
QVM1988/9/554a	5.2	37.9	22.7	0.60	0.14	20.1	11.9	0.59	0.53
QVM1988/9/554b	5.2	38.9	21.4	0.55	0.13	20.0	11.0	0.55	0.51
QVM1988/9/555a	5.5	38.4	20.7	0.54	0.14	19.1	10.3	0.54	0.50
QVM1988/9/555b	5.2	34.8	19.4	0.56	0.15	16.9	10.0	0.59	0.49
QVM1988/9/555c	5.2	36.9	20.2	0.55	0.14	17.3	9.8	0.57	0.47
QVM1988/9/555d	5.1	37.4	21.4	0.57	0.14	18.9	10.9	0.58	0.51
Ewart Creek									
TM E8747	5.0	32.5	20.2	0.62	0.15	17.2	12.0	0.70	0.53
Hibbs Lagoon									
QVM1988/9/43a	5.2	42.0	24.5	0.58	0.13	21.7	14.1	0.65	0.52
QVM1988/9/43b	5.0	37.8	21.4	0.57	0.13	18.0	13.0	0.72	0.48
Henty River									
TM E8814a	5.7	34.5	19.3	0.56	0.17	16.0	9.2	0.58	0.46
TM E8814b	5.0	31.0	19.5	0.63	0.16	15.5	9.1	0.59	0.50
Whyte River									
TM E8746	5.0	33.5	20.7	0.62	0.15	17.2	11.9	0.69	0.51
Magnet Range									
QVM1988/9/56	5.5	42.0	24.5	0.58	0.13	21.3	13.6	0.64	0.51
Mean dimensions	5.2	36.6	21.2	0.58	0.14	18.4	11.3	0.62	0.50

TABLE TWO

Caryodes dufresnii extra: comparative dimensions.

	Shell					Aperture			
	WN	SH	SD	SHD	WSH	AH	AD	AHD	ASH
Woods Figure 3b	5.2	38.0	16.0	0.42	0.14	16.0	8.0	0.50	0.42
Woods Figure 3a	5.0	33.0	17.0	0.52	0.15	17.0	8.0	0.47	0.52
Fowlers Point									
TM E17694	5.2	34.3	19.5	0.59	0.15	17.8	11.9	0.67	0.52
Stephens Bay									
QVM1988/9/550	5.5	33.6	18.0	0.54	0.16	15.2	9.0	0.59	0.54
Settlement Point									
TM E13073	4.9	32.0	20.0	0.62	0.15	16.0	10.2	0.64	0.50
Port Davey									
TM E925	5.2	34.3	20.0	0.58	0.15	15.8	11.7	0.74	0.46
QVM1988/9/551	5.3	33.9	18.0	0.53	0.16	16.7	9.3	0.56	0.49
Kelly Basin									
TM E2320	5.1	33.7	18.2	0.54	0.15	16.8	9.6	0.57	0.50
Maatsuyker Is.									
TM E7949	5.0	29.4	16.0	0.54	0.15	16.8	9.6	0.57	0.50
Cardia Cave									
QVM1988/9/558a	5.7	37.5	21.9	0.58	0.15	18.3	10.9	0.60	0.49
QVM1988/9/558b	5.0	34.0	19.4	0.57	0.15	17.0	10.4	0.61	0.50
QVM1988/9/558c	5.0	32.5	18.7	0.58	0.15	16.5	9.6	0.58	0.51
Cox Bight									
TM E4341	5.0	32.3	18.7	0.58	0.15	17.0	9.4	0.55	0.53
Southern Range									
TM E15464	5.0	33.4	19.9	0.60	0.15	19.6	9.8	0.50	0.50
Hastings Caves									
TM E4313	5.7	37.4	18.4	0.49	0.15	16.1	9.6	0.60	0.43
Mean dimensions	5.2	34.0	18.6	0.55	0.15	16.8	9.8	0.58	0.49
South Cape Mean									
TM E8591a,b	5.1	35.3	19.1	0.54	0.14	18.5	9.7	0.52	0.53

TABLE THREE

Caryodes dufresnii dertra: comparative dimensions.

	Shell					Aperture			
	WN	SH	SD	SHD	WSH	AH	AD	AHD	ASH
Woods Figure 2b	5.0	19.0	12.0	0.63	0.26	10.5	5.0	0.48	0.55
Woods Figure 2c	5.2	25.0	12.0	0.48	0.21	12.0	6.5	0.54	0.48
Prossers Forest									
TM E17693	5.0	24.6	15.5	0.63	0.20	13.5	9.1	0.67	0.55
Trevallyn									
QVM1988/9/559a	5.0	26.4	15.2	0.58	0.19	13.6	8.9	0.65	0.52
QVM1988/9/559b	5.5	25.5	14.3	0.56	0.22	12.7	7.3	0.57	0.50
Windermere									
QVM1988/9/552a	5.0	25.0	14.1	0.56	0.20	13.3	7.3	0.55	0.53
QVM1988/9/552b	5.2	21.5	12.4	0.58	0.24	11.0	7.1	0.65	0.51
Hillgrove									
QVM1988/9/560a	5.5	27.0	14.3	0.53	0.20	14.0	8.2	0.59	0.52
QVM1988/9/560b	5.2	25.1	13.3	0.53	0.21	12.3	7.8	0.63	0.49
Launceston									
TM E916	5.2	24.4	12.9	0.53	0.22	11.5	6.3	0.55	0.47
TM E930	5.0	21.3	13.3	0.62	0.23	12.0	8.0	0.67	0.56
TM E930	5.0	14.4	15.8	0.65	0.20	14.4	7.8	0.54	0.59
TM E8256	5.0	21.0	12.2	0.58	0.24	11.7	6.2	0.53	0.56
TM E919	5.0	22.5	13.9	0.62	0.22	12.3	7.6	0.62	0.56
Cataract Gorge									
TM E914	5.0	19.5	11.5	0.59	0.26	10.6	5.6	0.53	0.54
TM E8272	5.1	21.3	12.4	0.58	0.24	10.8	7.0	0.65	0.51
TM E8272	5.0	19.6	12.5	0.54	0.26	11.4	6.4	0.56	0.58
Patersonia									
TM E934	5.2	23.2	14.0	0.60	0.23	11.0	7.7	0.70	0.47
TM E934	5.0	24.1	13.4	0.56	0.21	12.8	7.4	0.58	0.53
George Town									
TM E8273	5.2	20.0	11.6	0.58	0.26	11.3	6.3	0.56	0.58
Conara									
TM E927	5.1	23.4	13.3	0.57	0.22	11.0	7.3	0.66	0.47
Mean dimensions	5.1	23.0	13.3	0.58	0.22	12.1	7.2	0.59	0.53

Remarks: The dimensions of the Tenison-Woods (1878) figures are based on the author's statement that all are natural size.

TABLE FOUR

Comparative dimensions: Underwood, The Glen & Sideling morphs.

	Shell				Aperture				
	WN	SH	SD	SHD	WSH	AH	AD	AHD	ASH
Underwood 1980									
QVM 1988/9/561	5.5	38.0	21.5	0.57	0.14	19.9	10.7	0.54	0.52
Underwood 1987									
QVM1988/9/40a	5.5	37.0	19.6	0.53	0.15	18.0	10.4	0.58	0.49
QVM1988/9/40b	5.3	30.5	17.5	0.57	0.18	17.0	8.2	0.48	0.56
The Glen 1985									
QVM1988/9/41	5.3	33.6	19.8	0.59	0.16	18.9	10.0	0.53	0.56
Sideling Range									
QVM1988/9/563a	5.5	37.0	22.1	0.55	0.15	19.6	10.2	0.52	0.53
QVM1988/9/563b	5.2	39.0	24.0	0.62	0.13	20.5	12.0	0.59	0.53
QVM1988/9/563c	5.5	40.5	22.2	0.55	0.14	20.0	—	—	0.60
Mean dimensions	5.4	36.5	21.0	0.57	0.15	19.1	10.2	0.54	0.54

TABLE FIVE

List of localities and dissected specimens used in the study.

Locality	Tasmap	Grid	Collector
1. Strahan			
TM E17695	Cape Sorell	67000.31600	R. & W. Kershaw
QVM1988/9/42	Cape Sorell	67000.31600	R. & W. Kershaw
2. Crotty River			
QVM1988/9/564	Franklin	85950.21100	R. & W. Kershaw
3. E. Hibbs Lagoon			
QVM1988/9/43	Spero	62100.85700	Steven Smith
4. Fowlers Point			
TM E17694	Port Davey	12700.07900	per S. Smith
5. Prossers Forest			
TM E17693	Pipers	16400.24100	R. & W. Kershaw
6. Underwood			
QVM1988/9/40	Pipers	17000.28500	Ian Norton
QVM1988/9/564	Pipers	17000.28500	Ian Norton
7. The Glen			
QVM1988/9/41	Pipers	07500.42100	R. & W. Kershaw
8. Sidling Range			
QVM1988/9/563	Pipers	35200.31200	R. & W. Kershaw
9. Mt. Arthur			
QVM1988/9/53	Pipers	20500.31800	R. & W. Kershaw
10. Mt. Barrow			
QVM1988/9/562	Pipers	35700.20100	R. C. Kershaw
11. South Sister			
QVM1988/9/553	Break O'Day	98500.00200	A. Daniell & R. C. Kershaw
12. Magnet Range			
QVM1988/9/56	Arthur	69400.10000	R. & W. Kershaw
13. Maria Island			
QVM1988/9/556	Maria	91000.88000	Colin Spry
QVM1988/9/557	Maria	91000.88000	Colin Spry
14. Esperance			
QVM1988/9/55	D'Entrecasteaux	02300.00800	Kevin Bonham
15. Bruny Island			
QVM1988/9/48	D'Entrecasteaux	26000.99000	J. Campbell
16. South Cape Bay			
TM E8591b,c	South Cape	83000.73000	J. Burrell
17. National Park			
QVM1988/9/46 (3)	Tyenna	76800.74700	R. C. Kershaw
18. Mt. Wellington			
QVM1988/9/45	Derwent	21000.48000	Kevin Bonham
19. Florentine			
QVM1988/9/47	Wedge	51400.70700	S. Hunniford & G. Leaman
20. Forestier Pen.			
QVM1988/9/51	Storm Bay	75800.38400	R. C. Kershaw
QVM1988/9/52 (2)	Storm Bay	75800.38400	R. C. Kershaw
21. Ben Ridge			
QVM1988/9/565	Forester	47600.23500	R. C. Kershaw
22. Winnaleah			
QVM1988/9/566	Forester	76400.44300	E. Armstrong & R. Farquhar
23. Kingston			
QVM1988/9/54	Derwent	27450.41800	Kevin Bonham
24. Ellendale			
QVM1988/9/49	Tyenna	74900.84600	R. C. Kershaw
QVM1988/9/50	Tyenna	74900.84600	R. C. Kershaw

ABBREVIATIONS USED IN THE ILLUSTRATIONS

Ag — albumen gland	.Bd — bursa duct
Bp — bursa duct pore	.Ca — carrefour region
D — bursa duct diverticulum	.E — prostate
Ep — epiphallus	.Fo — free oviduct
G — gonopore	.Ga — genital atrium
H — heart	.Hd — hermaphrodite duct
I — intestine	.K — kidney
Lv — main pulmonary vein	.Mo — penis
Mp — male duct pore	.Ms — epiphallic pilasters
R — rectum	.Rm — penial retractor muscle
S — stomach	.Sp — bursa copulatrix
T — talon	.U — primary ureter
Ud — oviduct (uterus)	.Up — ureter pore
Va — vagina	.Vd — vas deferens
Vp — vagina pilaster	.X — vagina pocket

